Appendix F
Stream Bank Erosion Methods and Results

Sediment TMDL Methods and Results

Introduction

This appendix documents the analytical techniques and data used to develop the gross sediment budget and instream sediment measures used in this TMDL. It describes the methods, data, and results for the 1) stream bank erosion inventory and 2) for surface and subsurface fine sediment data. These data are intended to characterize the natural and existing condition of the landscape, estimate the desired level of erosion and sedimentation, and provide baseline data that can be used in the future to track the effectiveness of TMDL implementation. For example, the stream bank erosion inventories can be repeated and will ultimately provide an adaptive management or feedback mechanism.

Stream bank Erosion Inventory

The stream bank erosion inventory used to estimate background and existing stream bank erosion followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). Using the direct volume method, sub-sections of 1996 303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

The NRCS stream bank erosion inventory is a field-based methodology, which measures stream bank/channel stability, length of active eroding banks, and bank geometry. The stream bank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of stream bank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

Bank Stability:

Do not appear to be eroding - 0
Erosion evident - 1
Erosion and cracking present - 2
Slumps and clumps sloughing off - 3

Bank Condition:

Some bare banks, few rills, no vegetative overhang - 0
Predominantly bare, some rills, moderate vegetative overhang - 1
Bare, rills, severe vegetative overhang, exposed roots - 2
Bare, rills and gullies, severe vegetative overhang, falling trees - 3

Vegetation / Cover On Banks:

Predominantly perennials or rock-covered - 0
Annuals / perennials mixed or about 40% bare - 1
Annuals or about 70% bare - 2
Predominantly bare - 3

Bank / Channel Shape:

V - shaped channel, sloped banks - 0
Steep V - shaped channel, near vertical banks - 1
Vertical Banks, U - shaped channel - 2
U - shaped channel, undercut banks, meandering channel – 3

Channel Bottom:

Channel in bedrock / non-eroding - 0
Soil bottom, gravels or cobbles, minor erosion - 1
Silt bottom, evidence of active downcutting - 2

Deposition:

No evidence of recent deposition - 1
Evidence of recent deposits, silt bars - 0

Cumulative Rating

Slight (0-4) Moderate (5-8) Severe (9+)

From the cumulative rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year	**Slight**
0.06 - 0.15 feet per year	**Moderate**
0.16 - 0.3 feet per year	**Severe**
0.5+ feet per year	**Very Severe**

Stream bank stability can also be characterized through the following definition and the corresponding stream bank erosion condition rating. Ratings from Bank Stability or Bank Condition, above, are included in italics.

Stream banks are considered stable if they do not show indications of any of the following features:

Breakdown - Obvious blocks of bank broken away and lying adjacent to the bank. *Bank Stability Rating 3*

Slumping or False Bank - Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*

Fracture - A crack is visibly obvious on the bank indicating that the block of bank is about to slump or move into the stream. *Bank Stability Rating 2*

Vertical and Eroding - The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Stream banks are considered covered if they show any of the following features:

Perennial vegetation ground cover is greater than 50%. *Vegetation/Cover Rating 0*

Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*

At least 50% of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*

At least 50% of the bank surfaces are protected by logs of 4-inch diameter or larger. *Vegetation/Cover Rating 1*

Stream bank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and Burton, 1993). The modification allows for measuring stream bank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

Mostly covered and stable (non-erosional). Stream banks are over 50% covered as defined above. Stream banks are stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 - 4 (slight erosion) with a corresponding lateral recession rate of 0.01 - 0.05 feet per year.*

Mostly covered and unstable (vulnerable). Stream banks are over 50% covered as defined above. Stream banks are unstable as defined above. Such banks are typical of "false banks" observed in meadows where breakdown, slumping, and/or fracture show instability, yet vegetative cover is abundant. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*

Mostly uncovered and stable (vulnerable). Stream banks are less than 50% covered as defined above. Stream banks are stable as defined above. Uncovered, stable banks are typical of stream banks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*

Mostly uncovered and unstable (erosional). Stream banks are less than 50% covered as defined above. They are also unstable as defined above. These are bare eroding stream banks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Stream banks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

Site Selection

The first step in the bank erosion inventory is to identify key problem areas. Stream bank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segment of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types).

Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates were extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. Typically between 10 and 30 percent of stream bank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property.

Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. The subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Stream bank erosion or channel stability inventory field methods were originally developed by the U.S. Forest Service (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983)

document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Field crews typically consist of two to four people and are trained as a group to ensure quality control or consistent data collection. Field crews survey selected stream reaches measuring bank length, slope height, bankfull width and depth, and bank content. In most cases, a Global Positioning System is used to locate the upper and lower boundaries of inventoried stream reaches. Additionally, while surveying field crews photograph key problem areas.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rates determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor. The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * \rho_B]/2000 \text{ (lbs/ton)}$$

where:
E = bank erosion over sampled stream reach (tons/yr/sample reach)
A_E = eroding area (ft^2)
R_{LR} = lateral recession rate (ft/yr)
ρ_B = bulk density of bank material (lps/ft^3)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:
E_R = bank erosion rate (tons/mile/year)
E = bank erosion over sampled stream reach (tons/yr/sample reach)
L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold et al. 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50-year flood event might cause five feet of bank erosion in one year and over a ten-year period this events accounts for the majority of bank erosion. These events have less of an influence where bank trampling is the major cause of channel instability.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding, such as the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed.

Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates, such as aerial photo interpretation, anecdotal data, bank pins, and channel cross-sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates.

The *bulk density* (ρ_B) of bank material is measured ocularly in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

Subsurface Fine Sediment Sampling

McNeil Sediment Core samples were collected to describe size composition of bottom materials in salmonid spawning beds of streams on the 303(d) list for sediment. Research has shown that subsurface fine sediment composition is important to egg and fry survival (Hall 1986); (Reiser and White 1988). Data gathered as part of this TMDL and other studies relevant to the Pahsimeroi River Subbasin are presented after the narrative section of this appendix.

Site Selection

Sample sites selected displayed characteristics of gravel size, depth, and velocity required by salmonids to spawn and were determined to be adequate spawning substrate by an experienced fisheries biologist. Samples were collected during periods of low discharge, as described in McNeil and Ahnell (1964), to minimize loss of silt in suspension within the core sampling tube. Sample sites were generally in the lower reach of streams where spawning habitat was determined to exist.

Field Methods

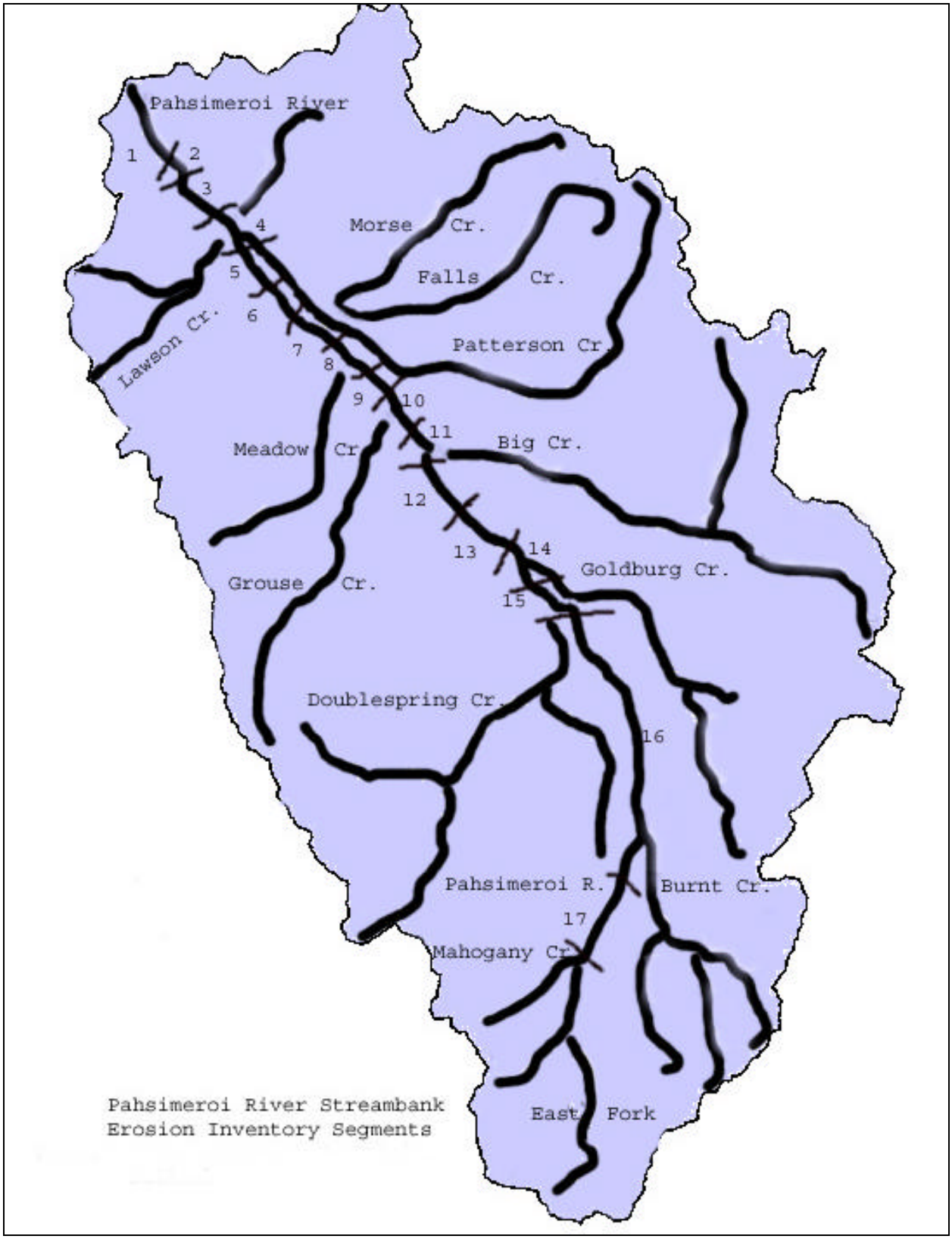
A 12-inch stainless steel open cylinder was worked manually as far as possible, at least 4 inches, into spawning substrate without allowing flowing water to top the core sampling tube. Samples of bottom materials were removed by hand, using a stainless steel mixing bowl, to a depth of at least 4 inches and placed into buckets. After solids were removed from the core sampling tube and placed into buckets, the remaining suspended material was discarded. It is felt that this fine material would be removed through the physical action of excavating a redd and would not be a significant factor with regard to egg to fry survival. Additionally, rinsing of sieves to process the sample results in some loss of the fraction below the smallest (0.053 mm) mesh size.

Samples were placed wet into a stack of sieves and were separated into 10 size classes by washing and shaking them through nine standard Tyler sieves having the following square mesh openings (in mm): 63, 25, 12.5, 6.3, 4.75, 2.36, .85, .212, .053. Silt passing the finest screen was discarded.

The volume of solids retained by each sieve was measured after the excess water drained off. The contents of each of the sieves were placed in a bucket filled with water to the level of a spigot for measurement by displacement. The water displaced by solids was collected in a plastic bucket and transferred to a 2,000 ml graduated cylinder and measured directly. Water displaced by solids retained by the smaller diameter sieves was also collected in a plastic bucket

and measured in a 250 ml graduated cylinder. Variation in sample volumes was caused by variation in porosity and core depth. All sample fractions were expressed as a percentage of the sample with and without the 63 mm fraction.

Three sediment core samples were collected at each sample site and grouped together by fractions 6.3 mm and greater and 4.75 mm to 0.53 mm. The results for a particular site are the percentage of 4.75 mm to 0.53 mm as a percent of the total sample. Standard deviation is calculated for estimates including and excluding particles 63 mm and above.


Pahsimeroi River
1
2
3
4
Morse Cr.
5
Falls Cr.
6
Lawson Cr.
7
8
Patterson Cr.
9
10
11
Big Cr.
Meadow Cr.
12
13
14
Goldburg Cr.
Grouse Cr.
15
Doublespring Cr.
16
Pahsimeroi R.
Burnt Cr.
17
Mahogany Cr.
East Fork
Pahsimeroi River Streambank
Erosion Inventory Segments

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Riparian Exclosure to above Burstedt Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	39.459	4737	0.38 %
	W	114	0.991		
Downstream	N	44	41.04	4668	
	W	114	2.337		

Stream Bank Erosion Calculations

AVE. Bank Height: 0.5 feet **bank to bank length (L_{BB})** 2640 feet

bank to bank Eroding Seg. Length 528 feet (Inventoried stream length X 2)

Percent eroding bank 0.20

Bank erosion over sampled reach (E) 0.45 tons/year/sample reach

Erosion Rate (E_R) 1.80 tons/mile/year

Feet of Similar Stream Type 16896 feet

Eroding bank extrapolation 7286.40 feet

Total stream bank erosion **6** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 0.6 tons/year/sample reach

Erosion Rate (E_R) 2.2 tons/mile/year

Feet of Similar Stream Types 16896.00 feet

Eroding bank extrapolation 7286.40 feet

Total stream bank erosion **7.7** tons/year

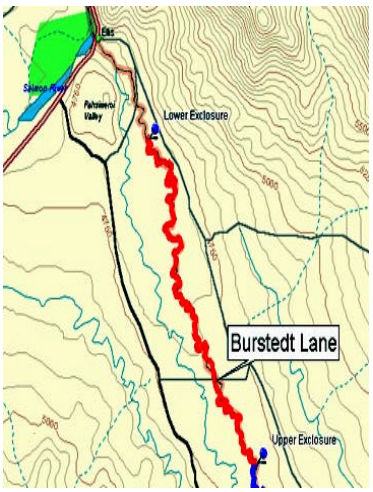
Comments

Flow a contributing factor?: Increased erosional energy at high flows. Flow is predominantly from Gldburg Creek and Springs.
Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.
Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.
Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reductions	Reach erosion rate load reduction	
1320	264	0.5			1	1	ss	Riparian exclosure fence to just above Burstedt Lane.	264	0	tons/year	264.0	1	tons/year
					2	0			Recession Rate			Recession Rate		
					3	0			0.04			0.05		
					4	0			Bulk Density			Bulk Density		
					5	1			85			85	**Total for segments after reductior**	
					6	1				0	tons/year		1	tons/year/sample
1320	264	0.5	#DIV/0!	#DIV/0!	sec. total	3								
			W/D Ratio	#DIV/0!	ecession Rate	0.04								

Total Inventoried Length	Total Erosive Length								Eroding Area	Average Reach erosion rate		Total Reduction	
1320	264	0.50			Ave. Rec.Rank	3			264	0	tons/year/sample	0	tons/year/sample
					Ave. Rec.Rate	0.04			Recession Rate				
									0.04				
Listed From:									Avg. Bulk Density				
Total Inventoried Stream Length:									85				
Listed Length:													
Total Stream Length													



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Above the Riparian Exclosure

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	38.457	4783	0.31 %
	W	114	0.001		
Downstream	N	44	39.459	4738	
	W	114	0.991		

Stream Bank Erosion Calculations

AVE. Bank Height: 1.5 feet **bank to bank length (L_{BB})** 2640 feet

bank to bank Eroding Seg. Length 1056 feet (Inventoried stream length X 2)

Percent eroding bank 0.40

Bank erosion over sampled reach (E) 3.70 tons/year/sample reach

Erosion Rate (E_R) 14.81 tons/mile/year

Feet of Similar Stream Type 13041 feet

Eroding bank extrapolation 11488.80 feet

Total stream bank erosion **40** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 1.7 tons/year/sample reach

Erosion Rate (E_R) 6.7 tons/mile/year

Feet of Similar Stream Types 13041.00 feet

Eroding bank extrapolation 5744.40 feet

Total stream bank erosion **18.3** tons/year

Comments

Flow a contributing factor?: Increased erosional energy at high flows.

Other contributing factors?: Increasing livestock use with direct access to streambanks along reach.

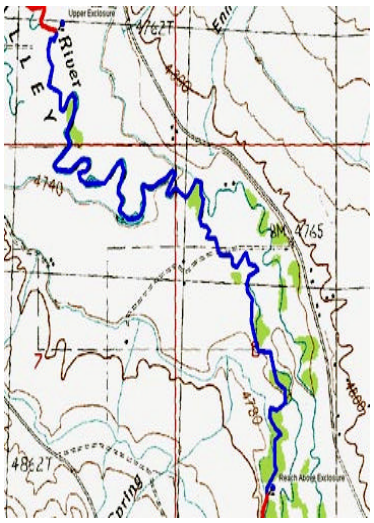
Other Notes: Inside meanders are largely vegetated with mature willows. Some sedge and perennial/annual grasses

Outside meanders are generally vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reductions	Reach erosion rate load reduction	
1320	528	1.5			1	1	ss-gvl	Riparian exclosure fence to just above Burstedt Lane.	1584	4	tons/year	792.0	2	tons/year
					2	0			Recession Rate			Recession Rate		
					3	1			0.055			0.05		
					4	0.5			Bulk Density			Bulk Density		
					5	1			85			85		**Total for segments after reduction**
					6	1				4	tons/year		2	tons/year/sample
1320	528	1.5	#DIV/0!	#DIV/0!	sec. total	4.5								
			W/D Ratio	#DIV/0!	Recession Rate	0.055								

Total Inventoried Length	Total Erosive Length											
1320	528	1.50			Ave. Rec.Rank	5			Eroding Area	Average Reach erosion rate		**Total Reduction**
					Ave. Rec.Rate	0.055			1584	4	tons/year/sample	2 tons/year/sample
									Recession Rate			
									0.055			
Listed From:									Avg. Bulk Density			
Total Inventoried Stream Length:									85			
Listed Length:												
Total Stream Length												



Stream Bank Erosion Inventory Worksheet

Stream Palsimeroi River

Section From upper bound of Above Exclosure to Hatchery Ponds

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	37.35	4829	0.28 %
	W	113	59.124		
Downstream	N	44	38.457	4783	
	W	114	0.001		

Stream Bank Erosion Calculations

AVE. Bank Height: 0.8 feet **ank to bank length (L BB)** 2640 feet

bank to bank Eroding Seg. Length 1848 feet (Inventoried stream length X 2)

Percent eroding bank 0.70

Bank erosion over sampled reach (E) 2.36 tons/year/sample reach

Erosion Rate (ER) 9.42 tons/mile/year

Feet of Similar Stream Type 15259 feet

Eroding bank extrapolation 23210.60 feet

Total stream bank erosion 30 tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 0.8 tons/year/sample reach

Erosion Rate (ER) 3.4 tons/mile/year

Feet of Similar Stream Types 15259.00 feet

Eroding bank extrapolation 6631.60 feet

Total stream bank erosion 10.6 tons/year

Comments

Flow a contributing factor?: No.

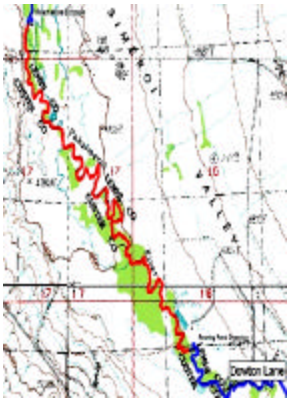
Other contributing factors?: Increasing livestock use with direct access to streambanks along reach.

Other Notes: Inside meanders are largely vegetated with mature willows. Some sedge and perennial/annual grasses

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recessio n Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	Eroding Area with Load Reductions	Reach erosion rate load reduction
1320	924	0.75			1	0	ss-gvl	Riparian exclosure fence to just above Burstedt Lane.	1386	2 tons/year	396.0	1 tons/year
					2	0			Recession Rate		Recession Rate	
					3	1			0.04		0.05	
					4	0			Bulk Density		Bulk Density	
					5	1			85		85	Total for segments after reduction
					6	1				2 tons/year		1 tons/year/sample
1320	924	0.75	#DIV/0!	#DIV/0!	sec. total	3						
			W/D Ratio	#DIV/0!	cession Rate	0.04						

Total Inventoried Length	Total Erosive Length								Eroding Area	Average Reach erosion rate	Total Reduction
1320	924	0.75			Ave. Rec.Rank	3			1386	2 tons/year/sample	2 tons/year/sample
					Ave. Rec.Rate	0.040			Recession Rate		
									0.04		
Listed From:									Avg. Bulk Density		
Total Inventoried Stream Length:									85		
Listed Length:											
Total Stream Length											



Looking Downstream from Hatchery Pond Diversion

Looking Upstream from Hatchery Pond Diversion

Hatchery Pond Diversion

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Hatchery Ponds to Patterson Creek Confluence

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	37.652	4863	0.37 %
	W	113	58.862		
Downstream	N	44	37.35	4829	
	W	113	59.124		

Stream Bank Erosion Calculations

AVE. Bank Height:	1.8	feet	**ank to bank length (L=n)**	5280	feet
bank to bank Eroding Seg. Length	1848	feet	(inventoried stream length X 2)		
Percent eroding bank	0.35				
Bank erosion over sampled reach (E)	12.37	tons/year/sample reach			
Erosion Rate (E =)	24.74	tons/mile/year			
Feet of Similar Stream Type	6600	feet			
Eroding bank extrapolation	6468.00	feet			
Total stream bank erosion	**43**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	3.9	tons/year/sample reach
Erosion Rate (E =)	7.9	tons/mile/year
Feet of Similar Stream Types	6600.00	feet
Eroding bank extrapolation	3696.00	feet
Total stream bank erosion	**13.7**	tons/year

Comments

Flow a contributing factor?: Increased erosional energy at high flows.

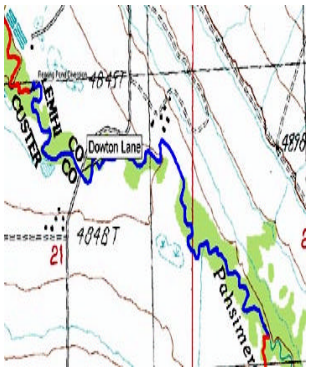
Other contributing factors?: Increasing livestock use with direct access to streambanks along reach.

Other Notes: Inside meanders are largely vegetated with mature willows. Some sedge and perennial/annual grasses
Outside meanders are generally vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Bank Slope	Strm Width	Strm Depth	Indv Rating	Recessi on Rank	Bank Material	Commen ts	Eroding Area	Reach erosion rate	with Load Reductions	Reach erosion rate load reduction
2640	924	1.75			1	1	ss-gvl	Riparian exclosure fence to just above Burstedt Lane.	3234	12 tons/year	1848.0	4 tons/year
					2	1			Recession Rate		Recession Rate	
					3	1			0.09		0.05	
					4	1			Bulk Density		Bulk Density	
					5	1			85		85	**Total for segments after reductio**
					6	1				12 tons/year		4 tons/year/sample
2640	924	1.75	#DIV/0!	#DIV/0!	sec. total	6						
			W/D Ratio	#DIV/0!	ession Rate	0.09						

Total Inventoried Length	Total Erosive Length							Eroding Area	Average Reach erosion rate		**Total Reduction**
2640	924	1.75			Ave. Rec.Rani	6		3234	12	tons/year/sample	8 tons/year/sample
					Ave. Rec.Rati	0.090		Recession Rate			
								0.09			
Listed From:								Avg. Bulk Density			
Total Inventoried Stream Length:								85			
Listed Length:											
Total Stream Length											



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Patterson Creek Confluence to Lower Martiny Reach

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 13:30

Land Use Grazing/irrigated pasture

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	35.397	4921	0.41 %
	W	113	56.84		
Downstream	N	44	36.815	4863	
	W	113	56.84		

Stream Bank Erosion Calculations

AVE. Bank Height: 1.3 feet **bank to bank length (L_{BB})** 2640 feet

bank to bank Eroding Seg. Length 792 feet (Inventoried stream length X 2)

Percent eroding bank 0.30

Bank erosion over sampled reach (E) 3 tons/year/sample reach

Erosion Rate (E_R) 10 tons/mile/year

Feet of Similar Stream Type 12830 feet

Eroding bank extrapolation 8490.00 feet

Total stream bank erosion **27** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 1 tons/year/sample reach

Erosion Rate (E_R) 6 tons/mile/year

Feet of Similar Stream Types 12830.00 feet

Eroding bank extrapolation 5660.00 feet

Total stream bank erosion **15.0** tons/year

Comments

Flow a contributing factor?: No, good access to well vegetated flood plain over most of reach.

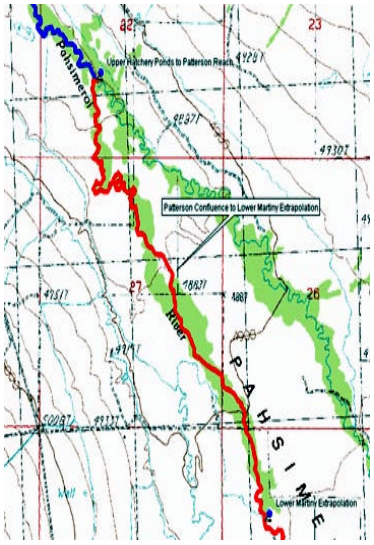
Other contributing factors?: Riparian wetland is hummocked due to livestock use diminishing bank storage and filtering.

Other Notes: Partitioned rotational grazing in effect: moderate seasonal. Thick willow dominated riparian zone on east edge of stream. Occasional clumping from adjacent cattle trails along of reach. Entire flow is diverted at upper section in dry years. Diversion improvement planned by IDFG

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	Eroding Area with Load Reductions	Reach erosion rate load reduction
1320	396	1.25			1	1	ss-gvl		990	2 tons/year	660.0	1 tons/year
					2	1.5			Recession Rate		Recession Rate	
					3	0			0.05		0.05	
					4	0			Bulk Density		Bulk Density	
					5	1.5			85		85	**Total for segments after reduction**
					6	1				2 tons/year		1 tons/year/sample
1320	396	1.25	#DIV/0!	#DIV/0!	sec. total	5						
			W/D Ratio	#DIV/0!	Recession Rate	0.05						

Total Inventoried Length	Total Erosive Length								Eroding Area	Average Reach erosion rate	Total Reduction
1320	396	1.25			Ave. Rec.Rank	5			990	3 tons/year/sample	1 tons/year/sample
					Ave. Rec.Rate	0.06			Recession Rate		
									0.06		
Listed From:									Avg. Bulk Density		
Total Inventoried Stream Length:									85		
Listed Length:											
Total Stream Length											



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Jimmy Martiny Land Inventory Below Hooper Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time:

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	34.599	4968	0.49 %
	W	113	55.785		
Downstream	N	44	34.892	4921	
	W	113	55.891		

Stream Bank Erosion Calculations

AVE. Bank Height:	2.0	feet	**Inv. bank to bank length (L_{BB})**	6102	feet
bank to bank Eroding Seg. Length	3660	feet	(Inventoried stream length X 2)		
Percent eroding bank	0.60				
Bank erosion over sampled reach (E)	37	tons/year/sample reach			
Erosion Rate (E_R)	63	tons/mile/year			
Feet of Similar Stream Type	6547	feet			
Eroding bank extrapolation	11513.82	feet			
Total stream bank erosion	**115**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	5	tons/year/sample reach
Erosion Rate (E_R)	9	tons/mile/year
Feet of Similar Stream Types	6547.00	feet
Eroding bank extrapolation	3839.20	feet
Total stream bank erosion	**16.4**	tons/year

Comments

Flow a contributing factor?: No. Spring Creek conditions.

Other contributing factors?: Cattle access to stream and severe chilselling.

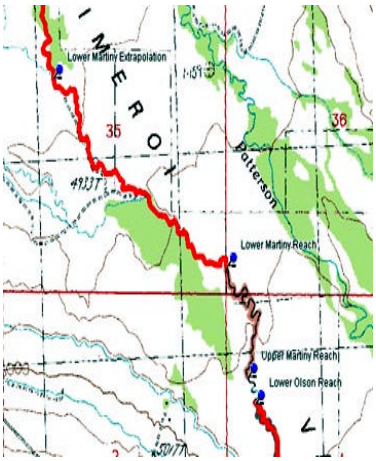
Other Notes: Whitefish and brook trout observed at several points over this reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reduction	Reach erosion rate load reduction	
1542	925	25			1	1	ilt-clay-loam		4625	65	tons/year	1542.0	3	tons/year
					2	2			Recession Rate			Recession Rate		
					3	2			0.33			0.05		
					4	3			Bulk Density			Bulk Density		
					5	2			85			85		
					6	0								
1542	925	25	#DIV/0!	#DIV/0!	sec. total	10								
			Ratio	#DIV/0!	Recession Rate	0.33								

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reduction	Reach erosion rate load reduction	
1509	905	15			1	1	ilt-clay-loam		2715	16	tons/year	905.4	2	tons/year
					2	1			Recession Rate			Recession Rate		
					3	1			0.14			0.05		
					4	2			Bulk Density			Bulk Density		
					5	2			85			85		
					6	0								
1509	905	15	#DIV/0!	#DIV/0!	sec. total	7							**Total for segments after reduction**	
			Ratio	#DIV/0!	Recession Rate	0.14				81	tons/year		5	tons/year/sample

otal Inventoried Lengtl	otal Erosive Length								Eroding Area	Average Reach erosion rate			Total Reduction	
3051	1830	2.00			Ave. Rec.Rank	9			3660	37	tons/year/sample		76	tons/year/sample
					Ave. Rec.Rate	0.24			Recession Rate					
									0.235					
Listed From:									Avg. Bulk Density					
Total Inventoried Stream Length:									85					
Listed Length:														
Total Stream Length														



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Olson Land Inventory Below Hooper Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 13:30

Land Use Grazing/irrigated pasture

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	33.9517	5002	0.47 %
	W	113	55.2133		
Downstream	N	44	34.526	4974	
	W	113	55.719		

Stream Bank Erosion Calculations

AVE. Bank Height:	0.8	feet	**bank to bank length (La)**	3346	feet
bank to bank Eroding Seg. Length	328	feet	(Inventoried stream length X 2)		
Percent eroding bank	0.10				
Bank erosion over sampled reach (E)	1	tons/year/sample reach			
Erosion Rate (Es)	2	tons/mile/year			
Feet of Similar Stream Type	9820	feet			
Eroding bank extrapolation	2253.26	feet			
Total stream bank erosion	4	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	1	tons/year/sample reach
Erosion Rate (Es)	4	tons/mile/year
Feet of Similar Stream Types	9820.00	feet
Eroding bank extrapolation	4597.20	feet
Total stream bank erosion	**8.0**	tons/year

Comments

Flow a contributing factor?: No, good access to well vegetated flood plain over most of reach. Watergap: 50' X 5.5' and erosive

Other contributing factors?: Riparian wetland is hummocked due to livestock use diminishing bank storage and filtering.

Other Notes: Partitioned rotational grazing in effect: moderate seasonal. Thick willow dominated riparian zone on east edge of stream. Occasional clumping from adjacent cattle trail along most of reach. Entire flow is diverted at upper section in dry years. Diversion improvement planned by IDFG

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	with Load Reductions	Reach erosion rate load reduction
1673	164	0.82	8	0.5	1	0.5	ss-gvl		268.96	1 tons/year	548.7	1 tons/year
				1.5	2	0.5			Recession Rate		Recession Rate	
				2.5	3	1			0.05		0.05	
				2	4	0			Bulk Density		Bulk Density	
				1	5	1			85		85	**Total for segments after reduction**
					6	1				1 tons/year		1 tons/year/sample
1673	164	0.82	8	1.50	sec. total	4						
			W/D Ratio	5.33333	cession Rate	0.05						
Total Inventoried Lengt	Total Erosive Length								Eroding Area	Average Reach erosion rate		**Total Reduction**
1673	164	0.82			Ave. Rec.Rank	4			269	1 tons/year/sample		-1 tons/year/sample
					Ave. Rec.Rate	0.05			Recession Rate			
									0.05			
Listed From:									Avg. Bulk Density			
Total Inventoried Stream Length:									85			
Listed Length:												
Total Stream Length												

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Hooper Lane to Lower BLM Land

eld Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

ate/Time: ######## 13:30

Land Use Grazing/irrigated pasture

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	31.988	5174	0.72 %
	W	113	51.493		
Downstream	N	44	33.228	5065	
	W	113	53.77		

Stream Bank Erosion Calculations

AVE. Bank Height:	1.3	feet	**: to bank length (L ra)**	2640	feet
Eroding Seg. Length	792	feet		(Inventoried stream length X 2)	
ercent eroding bank	0.30				
r sampled reach (E)	4	tons/year/sample reach			
Erosion Rate (E ra)	15	tons/mile/year			
imilar Stream Type	13728	feet			
g bank extrapolation	9028.80	feet			
tream bank erosion	**43**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	1	tons/year/sample reach
Erosion Rate (E ra)	6	tons/mile/year
Feet of Similar Stream Types	13728.00	feet
Eroding bank extrapolation	6019.20	feet
Total stream bank erosion	**16.0**	tons/year

Comments

Flow a contributing factor?: Yes, downcut over upper channel increasing erosion at elevated flow.

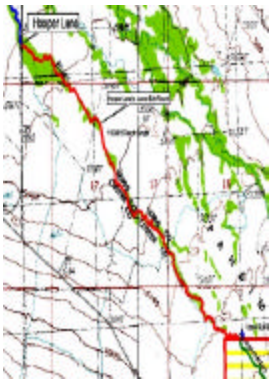
Other contributing factors?: Riparian Vegetation decreases to upper bound of reach decreasing stability of streambanks.

Other Notes: This reach is often dry during irrigation season.

Individual Bank Measurements

Inventoried Bank	Erosive Bank Lngth	Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments				Area with Load		Reach erosion rate load reduction
1320	396	1.25			1	1	ss		Eroding Area	990	4 tons/year	660.0	1	tons/year
					2	1			Recession Rate			Recession Rate		
					3	1			0.09			0.05		
					4	1			Bulk Density			Bulk Density		
					5	1			85			85	**Total for segments after reduction**	
					6	1					4 tons/year		1	tons/year/sample
1320	396	1.25	#DIV/0!	#DIV/0!	sec. total	6								
			W/D Ratio	#DIV/0!	sion Rate	0.09								

nventoried I	Erosive Length							Eroding Area	Average Reach erosion rate		**Total Reduction**	
1320	396	1.25		Ave. Rec.Ra	6			990	4	tons/year/sample	2	tons/year/sample
				Ave. Rec.Ra	0.09			Recession Rate				
								0.09				
Listed From:								Avg. Bulk Density				
Total Inventoried Stream Length:								85				
Listed Length:												
Total Stream Length												



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section BLM Land Inventory above Hooper Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time:

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	31.785	5200	0.92 %
	W	113	51.206		
Downstream	N	44	31.862	5174	
	W	113	51.347		

Stream Bank Erosion Calculations

AVE. Bank Height: 1.7 feet **ank to bank length (L=n)** 1968 feet

bank to bank Eroding Seg. Length 1968 feet (Inventoried stream length X 2)

Percent eroding bank 1.00

Bank erosion over sampled reach (E) 21 tons/year/sample reach

Erosion Rate (E =) 111 tons/mile/year

Feet of Similar Stream Type 1846 feet

Eroding bank extrapolation 5660.00 feet

Total stream bank erosion **60** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 1 tons/year/sample reach

Erosion Rate (E =) 7 tons/mile/year

Feet of Similar Stream Types 1846.00 feet

Eroding bank extrapolation 1132.00 feet

Total stream bank erosion **4.0** tons/year

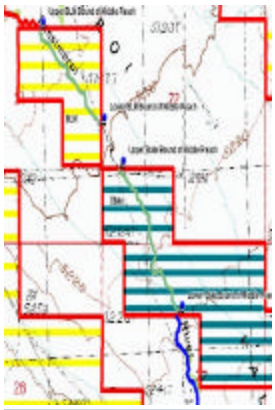
Comments

Flow a contributing factor?: Increased erosional energy at high flows. Flow is predominantly from Gildburg Creek and Springs.
Big Creek is dry below the USFS boundary diversion and not contributing flow at this time. Evidence of ice damming over reach.
Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.
Other Notes: Mostly sagebrush to streambank, progressively increasing cottonwood density, maturity, and canopy closure downstream.
This section will dewater with the biginning of irrigation season. Only flows in winter/moderat runoff: Jud Witworth.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Bank Slope	Strm Width	Strm Depth	Indv Rating	Recessi on Rank	Bank Material	Commen ts	Eroding Area	Reach erosion rate		with Load Reductions	Reach erosion rate load reduction	
984	984	1.65	10	2.5	1	1	lt-ss-gvl-cbl		3247.2	21	tons/year	649.4	1	tons/year
				2	2	1			Recession Rate			Recession Rate		
				0.5	3	2			0.15			0.05		
					4	1			Bulk Density			Bulk Density		
					5	2			85			85	**Total for segments after reductio**	
					6	1				21	tons/year		1	tons/year/sample
984	984	1.65	10	1.67	sec. total	8								
			W/D Ratio		6 ression Rate	0.15								

Total Inventoried Length	Total Erosive Length					Eroding Area	Average Reach erosion rate		Total Reduction	
984	984	1.65		Ave. Rec.Rani	8	3247	21	tons/year/sample	19	tons/year/sample
				Ave. Rec.Rati	0.15	Recession Rate				
						0.15				
Listed From:						Avg. Bulk Density				
Total Inventoried Stream Length:						85				
Listed Length:										
Total Stream Length										



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section State Land Inventory above Hooper Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	31.267	5240	0.80 %
	W	113	50.615		
Downstream	N	44	31.554	5210	
	W	113	50.894		

Stream Bank Erosion Calculations

AVE. Bank Height: 3.0 feet **ank to bank length (L=b)** 4298 feet

bank to bank Eroding Seg. Length 3248 feet (inventoried stream length X 2)

Percent eroding bank 0.76

Bank erosion over sampled reach (E) 37 tons/year/sample reach

Erosion Rate (E =) 92 tons/mile/year

Feet of Similar Stream Type 1609 feet

Eroding bank extrapolation 5679.84 feet

Total stream bank erosion **65** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 5 tons/year/sample reach

Erosion Rate (E =) 13 tons/mile/year

Feet of Similar Stream Types 1609.00 feet

Eroding bank extrapolation 1503.20 feet

Total stream bank erosion **9.6** tons/year

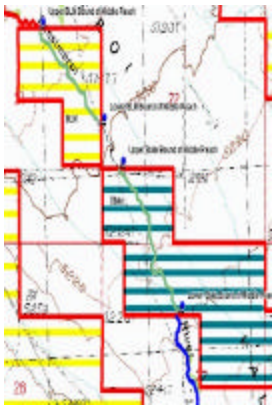
Comments

Flow a contributing factor?: Increased erosional energy at high flows. Flow is predominantly from Gildburg Creek and Springs.
Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.
Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.
Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Bank Slope	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	with Load Reductions	Reach erosion rate load reduction
2149	1624	3	15	0.2	1	1	ss-gvl-cbl		9744	37 tons/year	2578.8	5 tons/year
				0.5	2	1			Recession Rate		Recession Rate	
				1	3	1			0.09		0.05	
				1.5	4	1			Bulk Density		Bulk Density	
				0.5	5	1			85		85	**Total for segments after reductio**
				0.2	6	1				37 tons/year		5 tons/year/sample
2149	1624	3	15	0.65	sec. total	6						
			W/D Ratio	23.0769	ression Rate	0.09						

Total Inventoried Lengt	Total Erosive Length					Eroding Area	Average Reach erosion rate		**Total Reduction**
2149	1624	3.00		Ave. Rec.Rani	6	9744	37	tons/year/sample	32 tons/year/sample
				Ave. Rec.Rati	0.09	Recession Rate			
						0.09			
Listed From:						Avg. Bulk Density			
Total Inventoried Stream Length:						85			
Listed Length:									
Total Stream Length									



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section State Land Inventory above Hooper Lane

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	31.698	5385	0.78 %
	W	113	51.037		
Downstream	N	44	31.983	5240	
	W	113	51.049		

Stream Bank Erosion Calculations

AVE. Bank Height: 2.5 feet **bank to bank length (Lw)** 2640 feet

bank to bank Eroding Seg. Length 1320 feet (Inventoried stream length X 2)

Percent eroding bank 0.50

Bank erosion over sampled reach (E) 17 tons/year/sample reach

Erosion Rate (Ex) 67 tons/mile/year

Feet of Similar Stream Type 17160 feet

Eroding bank extrapolation 18480.00 feet

Total stream bank erosion **236** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 3 tons/year/sample reach

Erosion Rate (Ex) 11 tons/mile/year

Feet of Similar Stream Types 17160.00 feet

Eroding bank extrapolation 7392.00 feet

Total stream bank erosion **39.3** tons/year

Comments

Flow a contributing factor?: Increased erosional energy at high flows. Flow is predominantly from Gidburg Creek and Springs.
Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.
Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.
Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing
woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recessio n Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	with Load Reductions	Reach erosion rate load reduction
1320	660	2.5			1	1	ss-gvl-cbl		3300	17 tons/year	1320.0	3 tons/year
					2	1			Recession Rate		Recession Rate	
					3	2			0.12		0.05	
					4	1			Bulk Density		Bulk Density	
					5	1			85		85	**Total for segments after reduction**
					6	1				17 tons/year		3 tons/year/sample
1320	660	2.5	#DIV/0!	#DIV/0!	sec. total	7						
			W/D Ratio	#DIV/0!	cession Rate	0.12						

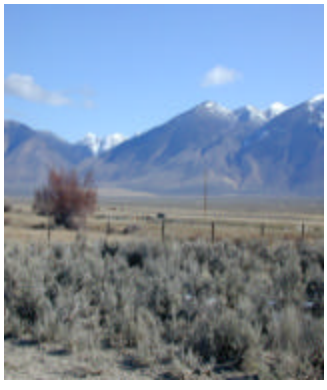
Total Inventoried Lengt	Total Erosive Length								Eroding Area	Average Reach erosion rate		**Total Reduction**
1320	660	2.50			Ave. Rec.Rank	7			3300	17 tons/year/sample		14 tons/year/sample
					Ave. Rec.Rate	0.12			Recession Rate			
									0.12			

Listed From: Avg. Bulk Density

Total Inventoried Stream Length: 85

Listed Length:

Total Stream Length



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Below Impoundment/Above Big Creek: Lower Section

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: 3/26/2001 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	28.672	5414	1.01 %
	W	113	48.953		
Downstream	N	44	29.112	5385	
	W	113	49.000		

Stream Bank Erosion Calculations

AVE. Bank Height: 0.5 feet **nk to bank length (LBB)** 2640 feet

k Eroding Seg. Length 528 feet (Inventoried stream length X 2)

Percent eroding bank 0.20

ver sampled reach (E) 0.6 tons/year/sample reach

Erosion Rate (BE) 2.2 tons/mile/year

of Similar Stream Type 1555 feet

ing bank extrapolation 1150.00 feet

l stream bank erosion **1.2** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 0.6 tons/year/sample reach

Erosion Rate (BE) 2.2 tons/mile/year

Feet of Similar Stream Types 1555.00 feet

Eroding bank extrapolation 1150.00 feet

Total stream bank erosion **1.2** tons/year

Comments

Flow a contributing factor?:

Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.

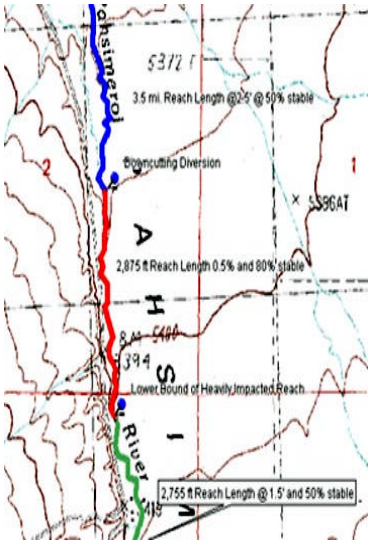
Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.

Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reduction	Reach erosion rate load reduction	
1320	264	0.5			1	1	ss-gvl-cbl		264	1	tons/year	264.0	1	tons/year
					2	0			Recession Rate			Recession Rate		
					3	1			0.05			0.05		
					4	0			Bulk Density			Bulk Density		
					5	1			85			85	**Total for segments after reductior**	
					6	1				1	tons/year		1	tons/year/sample
1320	264	0.5	#DIV/0!	#DIV/0!	sec. total	4								
			W/D Ratio	#DIV/0!	ession Rate	0.05								

nventoried l l Erosive Length											
1320	264	0.50			Ave. Rec.Ran	4		264	1	tons/year/sample	0 tons/year/sample
					Ave. Rec.Rate	0.05		Recession Rate			
								0.05			
Listed From:								Avg. Bulk Density			
Total Inventoried Stream Length:								85			
Listed Length:											
Total Stream Length											



Stream Bank Erosion Inventory Worksheet

Stream Pahsimerol River

Section Below Impoundment/Above Big Creek: Middle Section

Field Crew Tom Herron DEQ, Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Date/Time: ####### 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	28.662	5434	0.73 %
	W	113	48.948		
Downstream	N	44	28.267	5414	
	W	113	48.878		

Stream Bank Erosion Calculations

AVE. Bank Height: 1.5 feet **to bank length (LBE)** 2640 feet

Eroding Seg. Length 1320 feet (Inventoried stream length X 2)

Percent eroding bank 0.50

er sampled reach (E) 10 tons/year/sample reach

Erosion Rate (ER) 40 tons/mile/year

f Similar Stream Type 1435 feet

ng bank extrapolation 2755.00 feet

stream bank erosion **21** tons/year

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E) 2 tons/year/sample reach

Erosion Rate (ER) 7 tons/mile/year

Feet of Similar Stream Types 1435.00 feet

Eroding bank extrapolation 1102.00 feet

Total stream bank erosion **3.5** tons/year

Comments

Flow a contributing factor?:

Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.

Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.

Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Total Inventoried Bank	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	Eroding Area with Load Reductio	Reach erosion rate load reduction
1320	660	1.5			1	1	ss-gvl-cbl		1980	10 tons/year	792.0	2 tons/year
					2	1			Recession Rate		Recession Rate	
					3	2			0.12		0.05	
					4	1			Bulk Density		Bulk Density	
					5	1			85		85	**Total for segments after reduction**
					6	1				10 tons/year		2 tons/year/sample
1320	660	1.5	#DIV/0!	#DIV/0!	sec. total	7						
			W/D Rati	#DIV/0!	sion Rate	0.12						

nventoried : Erosive Length									Eroding Area	Average Reach erosion rate	Total Reduction
1320	660	1.50			Ave. Rec.Rat	7			1980	10 tons/year/sample	8 tons/year/sample
					Ave. Rec.Ra	0.12			Recession Rate		
									0.12		
Listed From:									Avg. Bulk Density		
Total Inventoried Stream Length:									85		
Listed Length:											
Total Stream Length											

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Below Impoundment/Above Big Creek: Upper Section

eld Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

ate/Time: ######## 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient	
GPS: Upstream	N	44	27.73	5463	0.79	%
	W	113	48.813			
Downstream	N	44	28.262	5434		
	W	113	48.875			

Stream Bank Erosion Calculations

AVE. Bank Height:	0.5	feet	**: to bank length (Lₑₓ)**	2640	feet
Eroding Seg. Length	528	feet	(Inventoried stream length X 2)		
ercent eroding bank	0.20				
r sampled reach (E)	0	tons/year/sample reach			
Erosion Rate (E ᵣ)	2	tons/mile/year			
imilar Stream Type	2337	feet			
g bank extrapolation	1462.80	feet			
tream bank erosion	**1**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	1	tons/year/sample reach
Erosion Rate (E ᵣ)	2	tons/mile/year
Feet of Similar Stream Types	2337.00	feet
Eroding bank extrapolation	1462.80	feet
Total stream bank erosion	**1.6**	tons/year

Comments

Flow a contributing factor?:

Big Creek is dry below the USFS boundary diversion and not contributing flow at this time.

Other contributing factors?: Previous heavy livestock use is evident and has likely predisposed this reach to significant bank erosion.

Other Notes: This segment is developing a new flood plain over much of the reach. Inside meanders are vegetated with colonizing woody species, some sedge and perennial/annual grasses. Outside meanders are vertical and erosive over most of the reach.

Individual Bank Measurements

Inventoried Bank	Erosive Bank Lngth	Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments						
1320	264	0.5			1	0	ss-gvl-cbl		Eroding Area	264	0 tons/year	Area with Load	264.0	1 tons/year
					2	0			Recession Rate			Recession Rate		
					3	1			0.04			0.05		
					4	0			Bulk Density			Bulk Density		
					5	1			85			85		**Total for segments after reduction**
					6	1					0 tons/year		1	tons/year/sample
1320	264	0.5	#DIV/0!	#DIV/0!	sec. total	3								
			W/D Ratio	#DIV/0!	sion Rate	0.04								

Inventoried	Erosive Length												
1320	264	0.50			Ave. Rec.Ra	3			Eroding Area	264	Average Reach erosion rate	0 tons/year/sample	**Total Reduction** 0 tons/year/sample
					Ave. Rec.Ra	0.04			Recession Rate				
									0.04				

Listed From: Avg. Bulk Density

Total Inventoried Stream Length: 85

Listed Length:

Total Stream Length

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section Above Impoundment/

eld Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

ate/Time: ######## 10:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient	
GPS: Upstream	N	44	26.273	5610	0.99	%
	W	113	46.495			
Downstream	N	44	27.552	5470		
	W	113	48.572			

Stream Bank Erosion Calculations

AVE. Bank Height:	0.8	feet	**: to bank length (Lₑₓ)**	2640	feet
Eroding Seg. Length	1056	feet	(inventoried stream length X 2)		
ercent eroding bank	0.40				
r sampled reach (E)	2	tons/year/sample reach			
Erosion Rate (E ʀ)	8	tons/mile/year			
imilar Stream Type	12883	feet			
g bank extrapolation	11362.40	feet			
tream bank erosion	**22**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	1	tons/year/sample reach
Erosion Rate (E ʀ)	3	tons/mile/year
Feet of Similar Stream Types	12883.00	feet
Eroding bank extrapolation	5681.20	feet
Total stream bank erosion	**9.1**	tons/year

Comments

Flow a contributing factor?:

Other contributing factors?:

Other Notes:

Individual Bank Measurements

Inventoried Bank	Erosive Bank Lngth	Bank Slope Hgt	Strm Width	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate	Area with Load	Reach erosion rate load reduction
1320	528	0.75			1	1	ss-gvl-cbl		792	2 tons/year	396.0	1 tons/year
					2	0			Recession Rate		Recession Rate	
					3	1			0.06		0.05	
					4	1			Bulk Density		Bulk Density	
					5	1			85		85	**Total for segments after reduction**
					6	1				2 tons/year		1 tons/year/sample
1320	528	0.75	#DIV/0!	#DIV/0!	sec. total	5						
			W/D Ratio	#DIV/0!	sion Rate	0.06						

nventoried I	Erosive Length							Eroding Area	Average Reach erosion rate		**Total Reduction**
1320	528	0.75			Ave. Rec.Ra	5		792	2	tons/year/sample	1 tons/year/sample
					Ave. Rec.Ra	0.06		Recession Rate			
								0.06			
Listed From:								Avg. Bulk Density			
Total Inventoried Stream Length:								85			
Listed Length:											
Total Stream Length											

Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi

Section (16) Upper BLM Reach above Pahsimeroi Road

Field Crew Tom Herron DEQ; Sr. Water Quality Analyst **Data reduced by** Tom Herron, DEQ

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	19.575	6531	1.84 %
	W	113	39.061		
Downstream	N	44	19.964	6479	
	W	113	39.221		

Stream Bank Erosion Calculations

AVE. Bank Height:	3.0	feet	**Inv. bank to bank length (L sb)**	5642	feet	**Stream Bank Erosion Reduction Calculations**
bank to bank Eroding Seg. Length	2630	feet	(inventoried stream length X 2)			
Percent eroding bank	0.47					
nk erosion over sampled reach (E)	95	tons/year/sample reach				**Bank erosion over sampled reach (E)** 39 tons/year/sample reach
Erosion Rate (E R)	177	tons/mile/year				**Erosion Rate (E R)** 73 tons/mile/year
Feet of Similar Stream Type	35640	feet				**Feet of Similar Stream Types** 35640.00 feet
Eroding bank extrapolation	35856.94	feet				**Eroding bank extrapolation** 15384.40 feet
Total stream bank erosion	**1291**	tons/year				**Total stream bank erosion** **531.9** tons/year

Comments

Flow a contributing factor?: No. Stream has developed a secondary flood plain after historic downcutting

Other contributing factors?: Variable cattle access related to bank slope and vegetative cover.

Other Notes: Mature cottonwood overstory with variable density understory. Stream course effected by combination of large coarse woody debris deposited in channel and erosive banks.

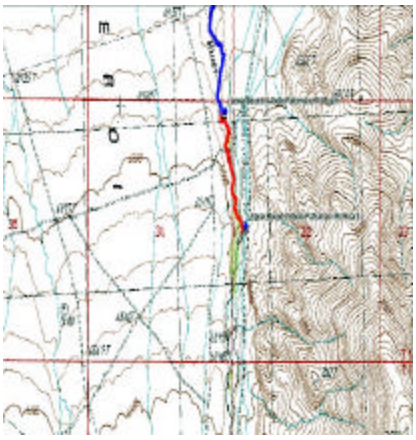
Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments				Area with Load	Reach erosion rate load reduction	
1870	935	3			1	2	ss-silt	Cattle accessing entire bank except for few willow thic	5610	83	tons/year	2244.0	33	tons/year
					2	2		This area covered with 1-3' of fine soil deposits and lik	Recession Rate			Recession Rate		
					3	2		a beaver meadow at one time. Large gully from bench	0.33			0.33		
					4	2		valley: not connected at this time.	Bulk Density			Bulk Density		
					5	2			90			90		
					6	0								
1870	935	3	#DIV/0!	#DIV/0!	sec. total	10								
			Ratio	#DIV/0!	Recession Rate	0.33								

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments				Area with Load	Reach erosion rate load reduction	
459	184	4			1	1	ss-silt	Cattle not accessing stream in this reach. Large coarse	1472	9	tons/year	734.4	5	tons/year
					2	1		debris affecting channel	Recession Rate			Recession Rate		
					3	1			0.14			0.14		
					4	2			Bulk Density			Bulk Density		
					5	2			90			90		
					6	0								
459	184	4	#DIV/0!	#DIV/0!	sec. total	7								
			Ratio	#DIV/0!	Recession Rate	0.14								

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments				Area with Load	Reach erosion rate load reduction	
492	196	2			1	1	ss-silt	Little access by cattle.	784	2	tons/year	393.6	1	tons/year
					2	1			Recession Rate			Recession Rate		
					3	1			0.06			0.06		
					4	1			Bulk Density			Bulk Density		
					5	1			90			90		
					6	0								
492	196	2.00	#DIV/0!	#DIV/0!	sec. total	5								**Total for segments after reductio**
			Ratio	#DIV/0!	Recession Rate	0.06				95	tons/year		39	tons/year/sample

otal Inventoried Leng	otal Erosive Length												
2821	1315	3.00			Ave. Rec.Rank	7			7890	63	tons/year/sample		56 tons/year/sample
					Ave. Rec.Rate	0.18			Recession Rate				
									0.17667				
Listed From:									Avg. Bulk Density				
Total Inventoried Stream Length:									90				
Listed Length:													
Total Stream Length													



Stream Bank Erosion Inventory Worksheet

Stream Pahsimeroi River

Section (17) Above Goldburg diversions to just below the confluence of Mahogany Creek

Field Crew Ann Dold;Oversite,Tom Herron DEQ; Sr. Water Quality **Data reduced by** Tom Herron, DEQ

Date/Time: 5/4/2001 14:00

Land Use Grazing

Stream Segment Location

		Degrees	Minutes	Elevation	Reach Gradient
GPS: Upstream	N	44	16.358	6873	1.48 %
	W	113	39.39		
Downstream	N	44	16.904	6815	
	W	113	39.184		

Stream Bank Erosion Calculations

AVE. Bank Height:	1.5	feet	**ık to bank length (LBB)**	7854	feet
k Eroding Seg. Length	6200	feet	(Inventoried stream length X 2)		
Percent eroding bank	0.79				
ver sampled reach (E	110	tons/year/sample reach			
Erosion Rate (ER)	147	tons/mile/year			
of Similar Stream Type	25924	feet			
ing bank extrapolation	47129.16	feet			
l stream bank erosion	**833**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	5	tons/year/sample reach
Erosion Rate (ER)	7	tons/mile/year
Feet of Similar Stream Types	25924.00	feet
Eroding bank extrapolation	11940.40	feet
Total stream bank erosion	**39.1**	tons/year

Comments

Flow a contributing factor?: Yes, Many Raw / down cut banks with some limited access to flood plain. High Flow does transport sediment to lower river though this section is dry at this time.

Other contributing fact: Appears to be little recruitment of willows. Recently heavily grazed though it is now fenced, needs long rest.

Other Notes: Flow infiltrates 4 miles below Mahogany Creek and 1.6 miles above the Road. The point of infiltration is variable depending upon flow, depth to groundwater and season. Conditions improve progressively upstream

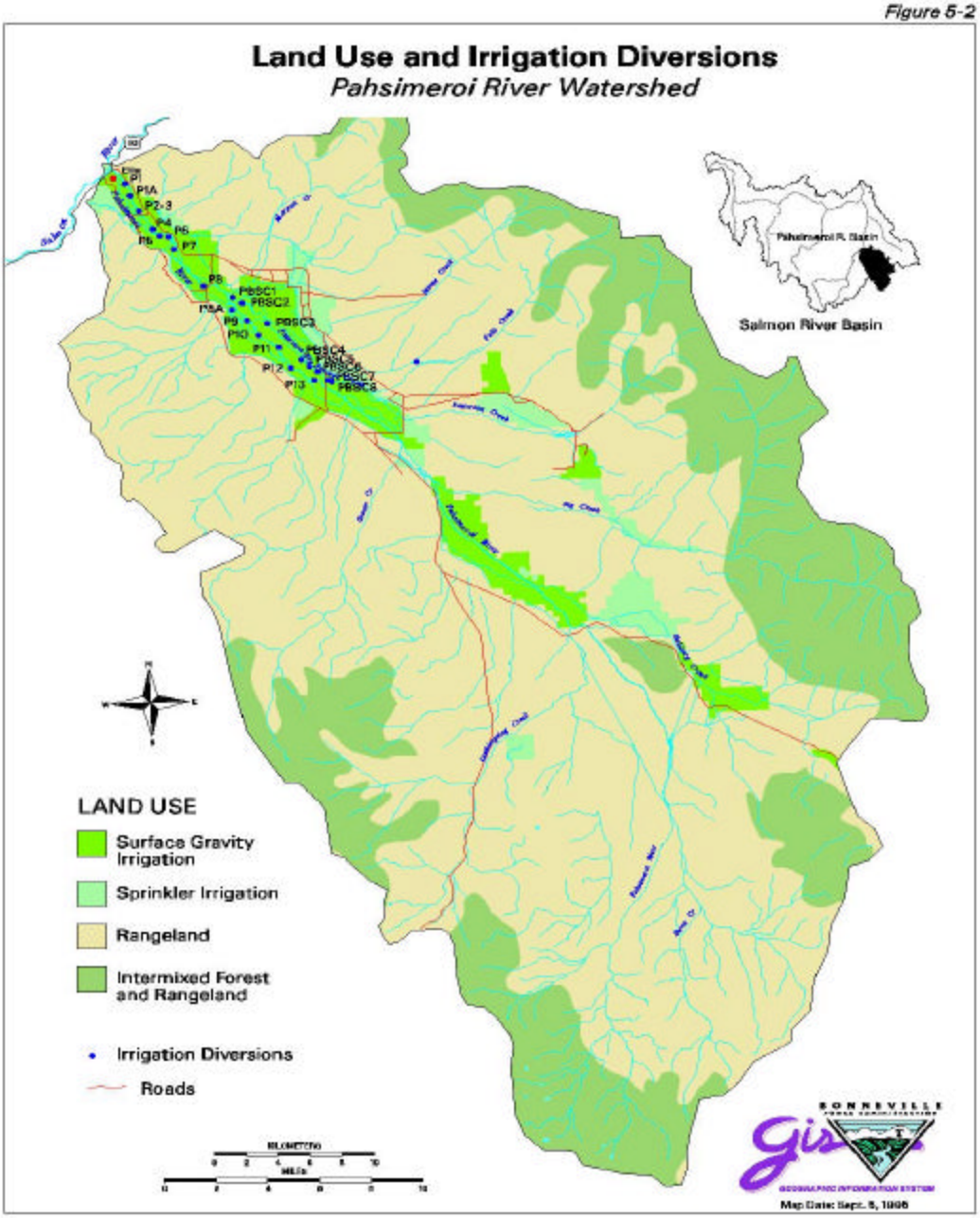
Individual Bank Measurements

Total Inventoried Bank Length	Erosive Bank Lngth	Average Bank Slope Hgt	Strm Wdth	Strm Depth	Indv Rating	Recession Rank	Bank Material	Comments	Eroding Area	Reach erosion rate		Eroding Area with Load Reduction	Reach erosion rate load reduction	
3927	3100	1.54			1	2	ss-gvl-cbl		9548	110	tons/year	2419.0	5	tons/year
					2	1			Recession Rate			Recession Rate		
					3	2			0.27			0.05		
					4	2			Bulk Density			Bulk Density		
					5	2			85			85	**Total for segments after reduction**	
					6	1				110	tons/year		5	tons/year/sample
3927	3100	1.54	#DIV/0!	#DIV/0!	sec. total	10								
			W/D Ratio	#DIV/0!	ssion Rate	0.27								

Inventoried Erosive Length													
3927	3100	1.54			Ave. Rec.Ra	10			Eroding Area	Average Reach erosion rate		**Total Reduction**	
					Ave. Rec.Ra	0.27			9548	110	tons/year/sample	104	tons/year/sample
									Recession Rate				
									0.27				
Listed From:									Avg. Bulk Density				
Total Inventoried Stream Length:									85				
Listed Length:													
Total Stream Length													

Appendix G
Bonneville Power Administration
Land Use and Irrigation Diversions Map for the Pahsimeroi Subbasin

Figure 5-2


Land Use and Irrigation Diversions
Pahsimeroi River Watershed
Salmon River Basin
LAND USE
Surface Gravity Irrigation
Sprinkler Irrigation
Rangeland
Intermixed Forest and Rangeland
Irrigation Diversions
Roads